Menlo Park Notebook #79 [N-79-06-16.2]

This notebook covers the period June 1879-April 1880. Most of the entries are by Francis Upton. There are also a few entries by Edison and John Kruesi. The entries by Upton consist of notes, calculations, and drawings relating to generators and electric power distribution, including costs. The entries by Edison include a "law" about the strength of dynamo machines and notes and drawings of chalks for the telephone. The entries by Kruesi consist of notes, calculations and drawings relating to the construction of dynamo machines. The label on the front cover is marked "Regulator" and "transmission." The book contains 282 numbered pages.

Blank pages not filmed: 56-57, 234-281.

Missing page numbers: 157-158, 231-232.

Page 225 Variable Mech'l 10
" 221 " " 5678910

No 79.

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 Broadway, New York.

[illegible]
GENERAL ELECTRIC
[illegible]
[illegible] 1, 1896.

June 16 1879

Standard ~~194~~ L
~~195~~

Bad connection so changed

208

~~No 3~~ 206 L
206 D

No. 3 186
196
206

No. 2

No. 1 211 R

Resolution of [illegible] may [illegible]
be concentrated

[illegible] 2 210 L

[illegible] 200 R
201 R

[illegible] 199 R
175

[illegible] 200 R

[illegible] 200 L

[illegible] make 50

Gramme on

Regulator

June 23 1879

4 inches of .003 20% Pt. Iridium wire. heated to ~~whiteness~~ brilliant yellow.

Having 6.9 Ohm resistance cold. When the regulator put on the wire fell to blackness

.003
3.14
3

.00942 surface 1 in
4

.03768

3 inches

6.9
1.72

5.18

2-10 P.M Commenced running on left hand point. 3 inches of .003 in Pt Ir 20% just red when still in the air changing red under the hand. Regulation very up no wt on spring

When spring red in air Yellow red under hand at 2-35 It ceased to regulate the wire becoming dull red now and then a few sparks stopped it. not sensibly warm. Lever not heated. Upper point badly eaten away. Changed direction of the current 2-40 P.M. so that the current should flow from the perfectly smooth lower point.

See page 13

a fly wheel would probably have smoothed this effect. At first there would be more powerful ups and downs in the current. Then it would gradually & have its speed become more constant until the sparks were made nearer to each other

How to test ?????

First put it into a shunt from the main current, so as to represent a number of lamps on the circuit The shunt representing one lamp and the note the deflection on a galvanometer.

See page 7

2-45 P. M.

In five minutes the regulation commenced to ~~[illegible]~~ work badly.

Stopped at 2 50 though regulated quite fairly

at 2-55 put on again.

3-05 stopped regulating

Started again

3-50 Stopped

81.4 Ohms in main circuit 25 Ohm spools very warm

16
2200 22
3200
32
35200

35000 grains

7000 grains in lbs

5 lbs

450
16
2800
450
7300

.003
3
.01

lamp

.03 in mine
1/10 of lamp

16)50(.31 in in lamp
48
20

Regulator running 8° = △
[illegible]
The weight on spring pulled
down 17° = 2
Wire bright yellow.

The spring raises a very small part of an inch in giving a spark. I can sight [illegible] over the Wt. and hardly see it rise when the machine is regulating

---

Mr. Edison suggests a regulator which shall move up and down so that perhaps three sparks a minute shall be given. The lever vibrates between two points making connection and breaking it, when it breaks it must fall a distance before making contacts, after

87 Ohm outside of regulator including wire

Put the machine direct without regulator through the wire. When I broke the main circuit ~~[illegible]~~ saw the wire melted with a snap

---

1.09
82
218
872
89.38 Volts

---

6 Daniells 60

58 over 5.8 Ohms

Bright yellow
1.09 Webers 1.09

.60

over 76 Ohms
Total

Add [illegible] for cooling
6 Ohms for cooling
82 Ohms Total
82 Volts on the circuit
around a shunt of 11.4 in
main circuit

22

79.2
13.4 [illegible]

.8470

1.419

16 [illegible] H.P.

16 [illegible] per H.P.

5.45 [illegible] running [illegible]
2 Ohms in machine

$\frac{2}{13.4}$ $\frac{2}{13.4} = \frac{10}{77}$ of Total

~~[illegible]~~

[illegible] Volts [illegible]

66) 82 (1.22
66
160
142
180

122
79.2 Volts
109
8.478
942
1026.78 Volts

[illegible] 20%

.003 20 %

20% 20%

.003 20% 20% 20%

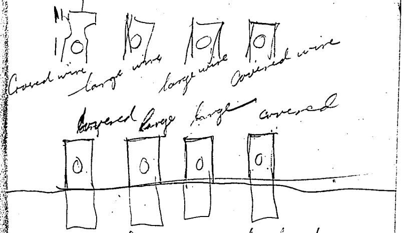
---

20 Volt
3

5.66	.8235
[illegible]	.8235
79	1.9542
49.	1.6464
	3.2476
	4.5135
	1.2709

18.6 per H.P.

10 | 30.31
14
20


Covered wire
large wire
large wire
Covered wire
covered
large
large
covered

12.5 Ohms in each foot
12.5 Ohms in each foot
12.5 Ohms in each ~~6~~ 21.7 | 5.4

3.1 $\frac{10}{3}$

.030 $\frac{10}{}$ surface

$\frac{1}{10}$ surface

5.4 Ohms cold

hot 2½ times greater

2.7
108
13.5 Ohms

.003 20% 3 inches

13.5 Ohms to 1/10 the surface should be better than an 100 Ohm lamp of 5/16

.004 20%

4 inches

314
.004
.01256
4
4

.003 10% represents the surface of a 180 Ohm lamp

Why a wire does not represent a lamp especially a short length.

In the first place there is not enough energy to heat the air that comes in contact with it by radiation

For example a wire stretched three inches say .003 of an inch in diameter has ~~nothing~~ 1/10 of the surface of a 100 ohm lamp of 5/16 surface ~~[illegible]~~ yet within a half inch of the bobbin is 1 1/2 inches say one ~~sq.~~ ~~in~~ of wire all of which has an effect in cooling the wire by convection while in the bare wire there are say 2 1/2 cu. inches of air

||||
Page 30

5/16 1/8 1/4

9/64 1/64

3/64

3/8 1/16 3/16

$$\begin{array}{r} 16 \\ 16 \\ \hline 96 \\ 16 \\ \hline 256 \end{array}$$

Bobbin

3/16 in diameter.

9/256 18/256 × 3.14 on ends

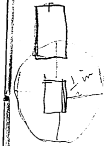
18

$$\begin{array}{r} 3.14 \\ 18 \\ \hline 2512 \\ 314 \\ \hline 56.52 \end{array}$$

57/256

say 1/4 in. high

9/16 × 1/4 = 9/



30 page 28

Thus with 1/10 the energy the straight wire has 1/2 again as much air to heat to prevent convection currents.

Secondly (b); conduction.
The straight wire while only giving off 1/10 of the energy, has perhaps ~~los~~ 1/4 of the loss by conduction to supports. about 2 1/2 times more proportionally.

.003 200%
55 over 7.5 Ohms. 31

~~[illegible]~~ Red bright
5 Daniells 50
55 over 7.5 Ohms

Yellow
60 L

Yellow bright
[illegible]0 L

Very bright yellow
70 L

Very bright yellow
74

75

80 yellow white

80 yellow white

over 7.2 [illegible]

Total in [illegible] 50

[illegible] 6

7.2) 6.00 (.84 Webers
5 7 6
3 0 0
2 9 8
1 . 2

.84
.84
100
44.3

$\bar{1}$.9243
$\bar{1}$.9243
$\bar{2}$.1
1.6464

3.4950
4.5185

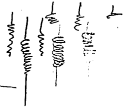
1.0235

10 per H.P

[illegible]

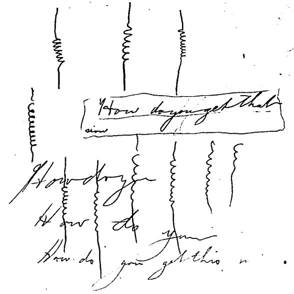
---

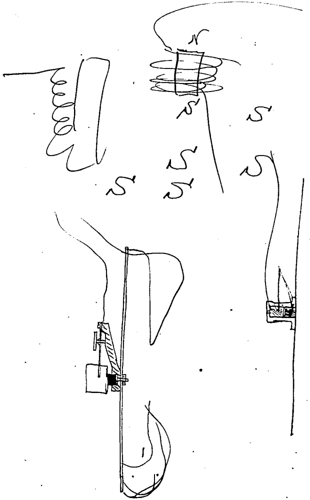
1 weber



[illegible]
.721

7.4 per H.P


How do you get that
siow
How do y
How do you
How do you get this n


N
S
S
S
S
S
S
1

Small regulator

[illegible] nearly
each one of commutation

---

4 [illegible]

1 cell 18° = D

~~[illegible]~~ 1
Could find no mark difference
in [illegible]

---

2 cells would reduce
the speed very [illegible] as though
Could [illegible] be [illegible]
The low even speed 32° = D
running free 25° = D
quite fast.

---

3 cells

Slightly faster than 1
the slow speed ~~[illegible]~~ with
2 cells 25° = D
4 cells same [illegible]
37° = D
5 cells [illegible]
6 cells 37° [illegible]
7 cells
59° 30' = D

Running fast
cells 36°
6 cells 33° 30'
5 cells 30° [illegible]
no mark
4 cells 27°
made [illegible] [illegible]
cells 21°

1 Ohm in circuit
6 cells 26 = D

New regulator
Charge 10 oz on spring

8 cells [illegible]

[illegible] 4° = A
little [illegible] 5°
7° = [illegible]
10° = A
way up 12° = D
[illegible]

5 cells
way up 12 =
very low 40 = [illegible]

---

4 cells way up not regulating
very low 5°

---

100 Ohms 8 per H.P.
How many Webers
100 X [illegible] 3 = 33 [illegible]
5

= 66 [illegible]

1.8195
1.6464
.1731
10865

~~1.49 Webers~~

149 ~~[illegible]~~

1.22 Webers
1.22 Volts

5 cells through 6 Ohm
gave 15° on galva

$\frac{10}{6} = \frac{5}{3}$ Weber

9° = Deflection for 1 Weber

For a 20 Ohm Lamp
the regulator should move
between keep the galvanometer be-
tween 9° and 12°

42

Regulator valv
of [illegible] current
any one 1/n of time
the current is regulat-
ed [illegible] for the mo-
ment [illegible] through
it [illegible] [illegible]
it gives off energy
The [illegible] regulation
must [illegible] a
spiral and [illegible] by
a galvanometer
Ex. First put the current
through a spiral
until the deflection

is 10 or 12 degrees 43
and note the color
The try the regulator
To adjust it that
~~n~~ the regulator and having
its own magnet [illegible]
[illegible] to the energy
of the current [illegible]
do the shape of [illegible]
[illegible] [illegible]
[illegible]
This [illegible] [illegible]
fact that [illegible]
[illegible] battery [illegible] on
the regulator the
current [illegible] flows

This current means time energy the galvanometer measures the average amount of electricity flowing through it. The test of a good regulator is that the strength of the current should [illegible] [illegible] of [illegible].

The regulator must have a constant amount of [illegible] and this ~~[illegible]~~ [illegible] pulling [illegible] and [illegible].

The best test of a regulator would be to Put it on an Electro dynamometer and see how near to a constant ~~current~~ deflection could be obtained [illegible] under varying conditions of current etc.

Put a sounder in circuit and obtained breaks showing that the regulator actually broke the current and [illegible] introduced the resistance of an arc.

1/6 How do you do

No weights

6 cells [illegible]

7° 30' just moves
the regulator but
does not start it

7 cells

8° 30' Starts part of the time
also jar moves it
faster than one
can count

9° still starts

9° 15 " " red

10° start yellowish red

11° running freely
yellow

10° starts, runs freely
yellow red

regulates to 6° 30'

6°

left running for 15 minutes
when regulator stopped
Jar started it

running free 9° 30'
~~dull~~ red

Full battery on
6° Spiral red
7° " yellow
8° " bright yellow

---

14 cells
6° regulator the same
spiral red

---

10 cells
8° spiral very dull red
This will spoil the meter

12° regulator stopped
very bright yellow
spiral twisted

Another spiral wound
much ~~[illegible]~~ twisted

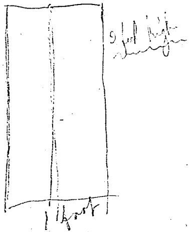
---

00 x Pt wire
spiral
~~bright~~ yellow but to
the bottom turn
13°
Pt on spring
necessary to ensure
contact
Regulator way up 9°
red spiral

Regulator just running
5°

Wt added to Governor
5° 30'
running much faster

New resistance coils



4 cells on magnet
1 division 7° 45'
spiral black

2 divisions 8°
faintest red

3 divisions
8° 20'

4 divisions
8° 45'
~~dull~~ light red

5 divisions 9° +
light red two turns
dark at bottom

6 9° 15'
bright red

7 9° 30'

8 9° 45'

9 divisions
10° —
10   10°
11   10° 15'
12   10 40'
~~2~~5 20   10° 30'
2~~1~~   1° 15
23 skipped

15 division 4 cells 10° 30
light red
15   5 cells 10°
15 divisions 6 cells
a little brighter 9° 45

---

3 divisions Wt on string for friction
7 cells   3-45 P.M
left ~~a way~~
very little difference in
color down to 4 cells
10° 30   yellow slightly red
at 4-15 both points
~~spa~~ making sparks
10° 30'

1.7 Gramme
from 8 Troy oz

1.7
3000
51000

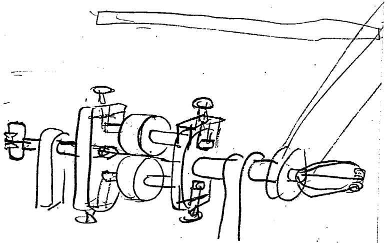
5100 Gramme

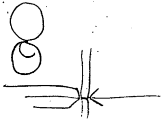
34)5100 (
34
7

31)5100 (161
31
200
186
40

28.3)5100.0 (180
283
2270
2264

180
15
900
180
2700

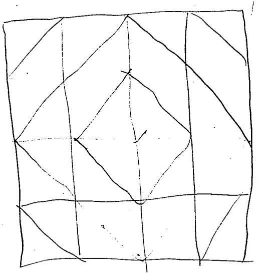


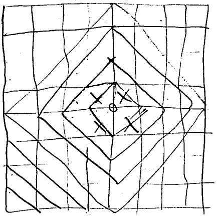


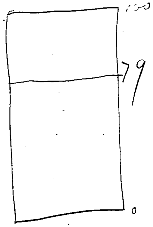
Aug 7

If $30 $30 for capital
$30 for capital
$30 for capital
capital
capital
capital
capital
capital
capital
capital
capital
capital
cage

rond
round







1	1750
2	1500
3	1250
4	1000
3	750
2	500
1	250
16	

3500

3000

2500

2000

1500

1000

500

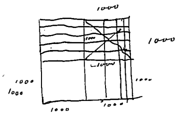
$$\begin{array}{r} 31.25 \\ 4 \\ \hline 125.00 \end{array}$$

95.50
70.32
70.32
48.82
48.82
48.82
125.
17.57
17.57
17.57
7.81
7.81
1.95

577.88

$$\begin{array}{l} 16)577(36 \\ \quad 48 \\ \hline \quad\ 97 \end{array}$$

2



8
100
100
100
100
1900

1	3800 1900		3800
2	3600	✓	3600
3	3400	✓	3400
~~6~~4	3200	✓	3200
5	3000	✓	3000
6	2800	✓	2800
7	2600	✓	2600
8.	2400	✓	
9.	2200	✓	
10.	2000	✓	
9.	1800	✓	
8.	1600	✓	
7	1400	✓	
6.	1200	✓	
5	1000	✓	
4.	800	✓	
3.	600	✓	
2.	400	✓	
1	200		
0	0		

16

10125
2
20250

90.25
3
27075

70.32
5
35160

61.25
6
36750

52.77
7
36939

45.00
8
360.00

37.80
9
34020

25.31
9
227.79

15.31
7
10717

11.25
6
6750

7.87
5
39.35

112.75
202.56 3600
270 75
320.00
351.60
367.50
369.39
360.00
340.20
312.50
227.79
160.00
107.17
67.50
39.35
20,00
8.43
2.50
.31
3640.30

369.39
369.39

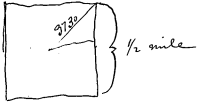
160 feet = $36.40 for each set

$364 per Camp

2000 X .8 = 1600

3200

2)5280
2640   2640

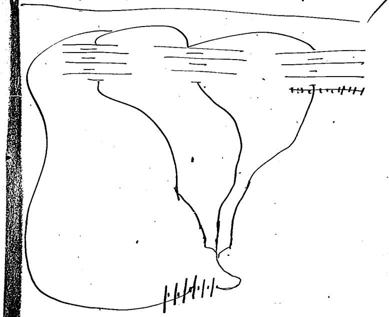

3730
1/2 mile

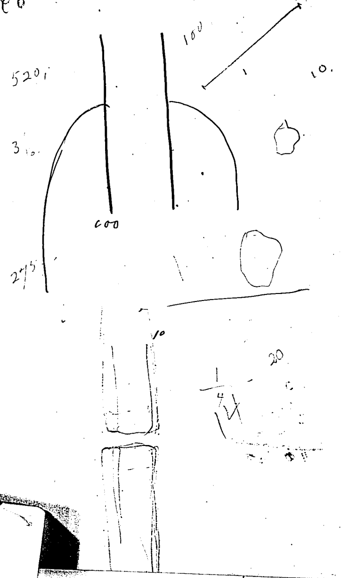
2640   3.4216
2640   3.4216
6.8432

6970000
6970000
13940000   7.1442
3.5721

3730

1/4 the ream




520
100
1
10.
3
600
275
10
20
1
4
14

50

50
50
2500
44.3

50
50
4
44.3

60000
44.

17600

17
1700000

50
50
4
44.3

1.6990
1.6990
0.6990
1.

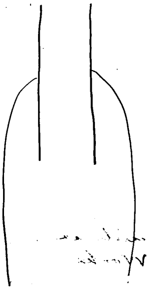
1700000
10000
17000
717
443.000

17 17
17000

17000
50
50
2500
4
10000

17.17

176000



1.2.5 Total

100 Volts in 1st 1 Ohm

50 V —— – 2nd 1/4 ohm

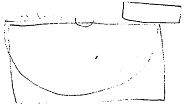
50

$$\frac{2500}{1.25} \times 44.3$$

2500	3.3979
44.3	1.6464
1.25	9.9031
	4.9474

88600 resistance

88600 Works



100

75

$\frac{25^2}{1.25} \times 44.3$

1.3979
1.3979
9.9031
1.6464

4.3453

22,100 resistance
3

66,300 work

90

$\frac{100}{1.25} \times 44.3$

2
9.9031
1.6464

3.5495

3540 resistance
9

31,860 work

$\frac{100}{2}$

50

44.3
50

2215.0 Resistance
9

19935. Work

33.3 1.5224
44.3 1.6464

3.1688

146

10 Ohms

100

~~4.430~~

10 Ohm
1 Ohm
$\frac{100}{11}$ 44.3.

2
8.9586
1.6464

2.6050

402 Resistance
9

3618. Work

Law

The strength of a Dynamo machine is as the square of its size If you double ~~you~~ the size of your machine it is four times as powerful.

---

100 Volts
90 opposing   0.9 of the the total work done in the machine

100 44.3

1 Ohm
4430
9
39870

---

2 Ohms
2500 2 7
44.3 1.6464
amp 2 9.6990
3.3454
.2215 9 0.9542
4.2996
19950

---

3 ohms 3|4430
1477
9
13293

---

4 Ohms 4|4430
1107
9
9963

5 Ohms 5|4430
886
9
7974

---

6 Ohms
738
6646

---

7 Ohms 7|4430
633
9
5697

14 Ohms
316
2848

---

8 Ohms
553
4981

16 Ohms
27.6
2493

---

9 Ohms
492
4431

18 Ohms
246
2215

---

10 Ohms
443
3987

20 Ohms
221
1993

---

11 Ohms 11|4430
427
9
3843

12) 00030 .24
367 164
9
3321 166.0

---

80 Volts on receiving
100 Volts on sending

20 Volts on line

---

1 Ohm sender
1 Ohm receiver
[illegible] 400

$$\frac{400}{2} = 200$$

44.3
200
8860.0
4
35440

---

1 Ohm sender
2 Ohm

44.3
400
3) 17720.0
5906.6
4
23626.4

4 Thurs Total 4/17720

4430

17720

5/17720 25

3544 708

4 2835

14176

6/17720 30

2953 590

4

11732 2346

7/17720 14 1265

2531 5063

4

10124

8/17720

2215 1107

4

8866 4443

160000

4000

9/4

120

120

14400 4.1584

2.5 9.6021

44.3 1.6464

5.4069

4.5185

250,000 .8884

4i

16

6

12)96 8

17

9 | 17720 18
7969 984
4 3938
7876

1772 20 886
4 3544
7088

---

11 | 17720 22
1611 805
4 3222
6444

---

12 | 17720 24
1477 738
~~9~~4 2954
5908

30
30
900

44.3
900.
39870.0

39870

7
3

2 | 39870
3 | 19935
6645
7
46515

93030 1 Ohm Total

2 | 46515 2 Ohms Total
2 | 23257 4 Ohms Total
2 | 11628 8 Ohms Total
2 | 5814 16 Ohm
2 | 2907 32 Ohm
1453 64 Ohms

---

3 | 46515
3 | 15505 6 Ohm
2 | 7752 12 Ohm
2 | 3876 24 Ohm
1936 48 Ohms Total

---

3 | 15505
5168 18 Ohms

3) 93030

3) 31010 — 2 Ohms

10336 — 9 Ohms

18606 — 5 Ohms

9303 — 10 Ohms

---

60 Volts Opposed

100

40 Volts active

1600

44.31
1600

2) 265800

13290

3

) 39870

6

2.50
1.45

44.3
1600

265800
443

2) 170880

35440

2) 70880 — ~~20~~

2) 35440 — 2 Ohms

2) 17720 — 4 Ohms

2) 8860 — 8 Ohms

2) 4430 — 16 Ohm

2215 — 32 Ohm

35440
3

2) 106320

2) 53160 — 2 Ohms

2) 26580 — 4 Ohms

2) 13290 — 8 Ohm

2) 6645 — 16 Ohms

2) 3322 — 32 Ohms

1661 — 64 Ohms

3) 106320

3) 35440 — 3 Ohms

3) 11613 — 9 Ohms

3) 3671 — 27 Ohms

1224 — 81 Ohms

3544 — 30 Ohms

5316 — 20 Ohms

3) 53160

3) 17720 — 6 Ohm

3) 5907 — 18 Ohm

1969 — 54

2) 17720

2) 8860 — 12 Ohm

2) 4430 — 24 Ohms

2215 — 48 Ohms

50 Volts

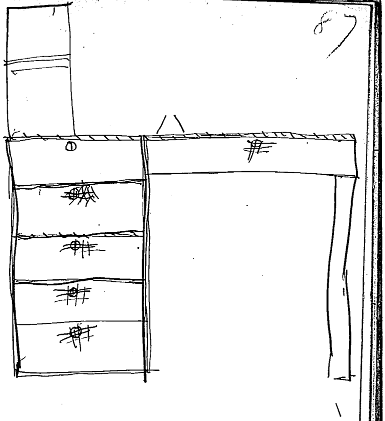
443
2500
221,500
886

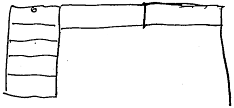
2 / 110,750.0 — 1 Ohm
2 / 55375 — 2. Ohms
2 / 27687 — 4
2 / 13843 — 8
2 / 6921 — 16
2 / 3460 — 32
1730 — 64

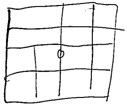
3 / 110.750
3 / 36916 — 3 Ohms
3 / 12305 — 9 Ohm
3 / 4101 — 27 Ohms
1367 — 81 Ohms

2 / 36916
2 / 18458 — 6 Ohms
2 / 9229 — 12 Ohm
2 / 4614 — 24 Ohms
2307 — 48 Ohms

22,150 5 Ohms
11075 10 Ohms
5537 20 Ohms
3692 30 Ohm
2768 40 Ohms







$7x - 3y = 1$

$11z - 7u = 1$ $\qquad y = \frac{7x-1}{3}$

$4z - 7y = 1$

$19x - 3u = 1$ $\qquad u = \frac{19x-1}{3}$

$$11z - \frac{\overset{133}{\cancel{49}\ \cancel{7x}+9x} - 7}{3} = 1 \qquad \begin{array}{r} \cdot 19 \\ 7 \\ \hline 133 \end{array}$$

$$4z - \frac{49x-7}{3} = 1$$

$$7z - \frac{84x}{3} = 1$$

$$21z - 84x = 3$$

$$\cancel{12}\ z = \frac{84x+3}{21} = 4x + \frac{1}{7}$$

$$\underline{16x + \frac{4}{7}} - \frac{49x-7}{3} = 1$$

$$\underline{48x + \frac{12}{7} - 49x + \frac{49}{7}} = 3$$

$$-x = -\frac{61}{7} + \frac{21}{7} = -\frac{40}{7}$$

$$x = \frac{40}{7}$$

$7x - 3y = 1$

$11z - 7u = 1$

$4z - 7y = 1$

$19x - 3u = 1$

$49x - 21y = 7$

$12z - 21y = 3$

$49x - 12z = 4$

~~$12z$~~ -

$33z - 21u = 3$

$133z - 21u = 7$

$133x - 33z = 4$

$49x - 12z = 4$

$84x - 21z = 0$

~~$7x - \frac{12}{7}z = 4$~~

$12x - 3z = 9$

$12x - 3z = 9.$

$48x - 12z = 0$

$x = 4$ $y = 9$

$z = 16$ $u = 25$

$$\begin{array}{r} 12 \\ 12 \\ \hline 132 \\ 1 \\ \hline 131 \\ 1 \end{array} \quad 7$$

$$\begin{array}{r} 16 \\ 16 \\ \hline 175 \\ 25 \end{array}$$

$$\begin{array}{r} 16 \\ 4 \\ \hline 64 \\ 63 \end{array}$$

---

p65

2165 1/2 mile areas

4000 : 2165 :: 5280 : x

$$\begin{array}{rr} 5280 & 3.7226 \\ 2165 & 3.3355 \\ 4000 & 6.3979 \\ \hline & 3.4560 \end{array}$$

2850

$63.50

1 mile area

$$\begin{array}{r} 63.50 \\ 4 \\ \hline \$253.00 \end{array}$$

1 Ohm machine

10 machines 100 Volts
10 Receivers 75 Volts
15 Ohms in conductor

Ohms 15 in conduct
" 20 " machines
35

250 Volts

250 2.3979
250 2.3979
44.3 1.6464
comp 35 8.4559 −10
4.8981
.4771
79,100 5.3752
3 4.5185
237.3 00 .8567
7.18
~~5.77~~ H.P.

1000 Volts on line

1/2 Ohm machines
15 Ohms in conductor
10 " " machines

25 Ohms total

~~[illegible]~~ 7.18
1.43
7
~~7.14~~ 10.01
~~7~~
~~7.98~~ H. P. given off by machines
10.01

1.[illegible] H. P. per machine

150 Volts from 1/4 Ohm machine
100 Volts receiver

50 Volts active
10 machines
500 Volts active 20 ohms Total
500 250000
500
20 / 4,4,3
2.215

4 / .2215.000~~0~~
553,000 ft lbs
2
1,166,000
5.7427
4.5185
1.2242
16.7 H.P. in resistance
2
33.4 H.P. in work
3.34 H.P. per machine
1500 Volts on line

3860 feet .2 in diam
cost $114.

20 miles

~~#~~ 25/16

114 2.0569
25 1.3979
comp 16 8.7959
2.2507

~~$178~~ $178 2.2504
5280 3.7226
20 1.3010
comp 3860 6.4134
3.6874
$ 4.860

1.4370
8.6021
1.2041
17.5 Ohms 1.2432

Conductor $5.000
20 Machines 2000
Turbine &c 2.000
$9.000

33.4 H.P.

9.000 3.9542
33.4 1.5237
2.4305
$270 per H.P.

$27 a year

1.4305
365 2.5623
$\bar{2}.8672$

$0.0735 ~~cts.~~ per day per H.P.
7.35 cts.

.8672
24 1.3802
$\bar{1}.4870$

.3 cts
3 mills per hour

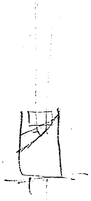
1/3 of a cent per hour for H.P. for the interest on plant

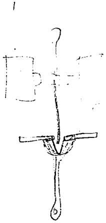
	750	2.8751
	750	2.8751
Comp	20	8.6990
	44.3	1.6464
		6.0956

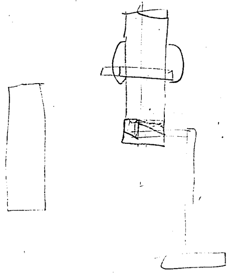
1,240,000

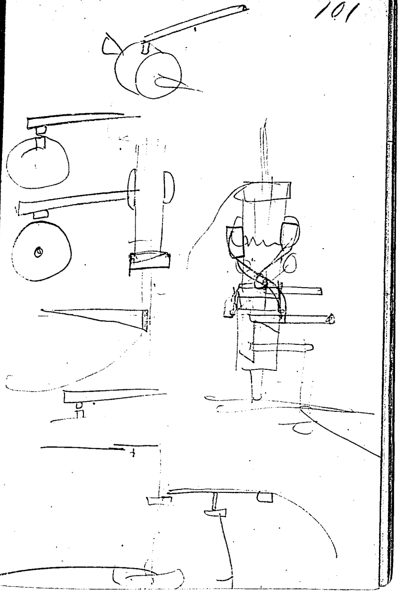
~~250000. 5.3979~~
~~18. 1.2553~~
~~4.1426~~

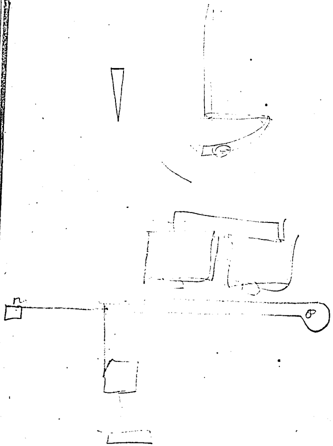
~~13800~~

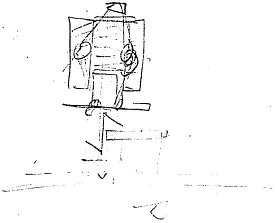


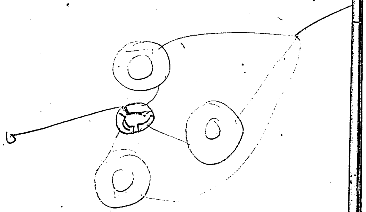


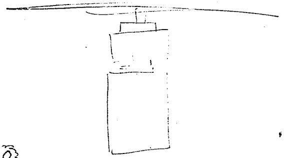


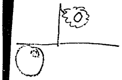












3 miles distance

150 Volts ~~receiver~~ sending instrument
100 Volts receiver   92% machines

1 Machine	1 Ohms Total	
5 Machines	2 Ohms	Volts
10 Machines	3 Ohms	
	4 Ohms	
15 Machines	5 Ohms	
20 Machines	10 Ohms	
	15 Ohms	
25 Machines	20 Ohms	
30 Machines	25 Ohms	
40 Machines	30 Ohms	
50 Machines	35 Ohms	
	40 Ohms	
	50 Ohms	
	60 Ohm	

$$\begin{array}{r} 92 \\ 92 \\ \hline 184 \\ 828 \\ \hline .8464 \end{array}\ \%$$

200
180

1000 feet   .101 Diameter

1 Ohm

$\frac{1}{.101} \times \frac{1}{101}$

$$\begin{array}{r} 101 \\ 101 \\ \hline 101 \\ 101 \\ \hline 10201 \end{array}$$

$\frac{1}{102}$

7.9914

$\bar{2}.09805$

1000 feet

.101

$\frac{100\cancel{201}}{1\cancel{000}}$

.101 Diam

.001

101
101
101
1.01
10201
1000 = 10.2 Ohms

60
32
28

$\frac{9}{1}$ $\frac{5}{9}$

15

10.2

$\frac{1}{1.05}$ 1.02

.0038
15
190
38
.0570

= 9.71'

.0086
.0212
.9874

1 Mile of Cu

5280
2640

½ mile 2640 feet
.164 in. in diam.

1 mile
.328 in. in diam.

½ mile .0205
4
1 mile .0410

100.00
[illegible]
443.000

217.8 lbs
4
871.2 lbs

$ 54.45
4
$ 217.80

1910
100

110

~~60° [illegible] Annealed [illegible]~~
Phelps Dodge & Co

	1 Ohm	Cost	2 Ohms		3 Ohms
	Weight	Cost 25cts			
1 mile					
2 miles					
3 miles					
4 miles					
5 miles					
10 miles					
15 "					
20 "					
25 "					
30 "					
35 "					
40 "					
50 "					
60 "					

14
14
56
14
196

111

~~13939~~

4)871.20.
21780

871.2
36
52272
26136
31363.2

871
49
7839
3484
4)4267900
1066975

7841
7
80569

(1960250
4900625

4)784100
196025

4)2178000
544500

1000
1000

2) 1000000 (
50,000

1000

44.3
50000
2,215,000.0

33) 2,215,000 (66 H, P.
1.98
235

33) 2215 (

20

66 H, P.
66
132 H, P.
264 H, P,

20

5. ~~4(20)~~

40,000

66
4
264 H, P.

1000 Volts effective

1500
2000
2500
3000
4000
5000
6000
700
1000
1500
2000

2/1000000
500000

1000
1500
2000
250

1000	1000	1000
1500	1500	1500
2000	2000	2000
2500	2500	2500
3000	3000	3000
4000	4000	4000
5000	5000	5
6006		
7000		
8000		
9000		

1.1277
7.5 .8751
7.5 .8751
2.8779

~~7326~~
755

1
2
3
4
5
8
10
15
20
25
30
35
40

100 Volts
100
10000
44.38

33)443000 (ft. lbs. 13.42 H.P.
33
113
99
140
132
80

1.5
1.5
75
15
225

1277
3522
.4799

3019 3019

13.42
1.5
1.5

1.1277
0.1761
0.1761
1.4799

1.5
1.5

12078
9
108702

13.42
2.5
2.5

1.1277
.3979
.3979
1.9235

8385
4
33540

1342
9
12078

8780
4
351.20

1342
3355

3000 Volts active.
9000 Total
90 machines

90) 377 (4. HP. per machine

90 machines
35 ohms

90 machines
45 Ohms

1.88
2
3.76
3.76

3.77
8

$100

Cost of water power

10.0
365 cost of water power
.4378

.0274 cost of dynamo
24) .0274 (001

60 machines 150 Volts each

(30 Ohms

30 30 30 30 30
30 30 30
30 3

6000 H.P.
$ 6000 Trans
$ 6000 receiver
4 Ohms $ 5445 10 mills
23.445

1.88
2
3.76

376 H.P.
75
300

300) 23445 (
$ 76.15

$75 per H.P.

118 $1 interest per day

$\frac{.1}{365}$ = .000274

~~001~~ 10

$100

$.0274

2.74cts interest per day on $100

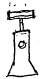
2.74 0.4378
24 1.3802
$\bar{1}$.0576

1.14 mills per hour

2.74
.365
1370
1644
822
1000.10

$10.00 a year

119



$\frac{1}{4}$ Ohm 1/4 Ohm

$

$\frac{1}{4}$ Ohm

1/4 1/4

100 per H.P.

$\frac{1}{4}$ Ohm

1/4 Ohm $\frac{1}{4}$

$\frac{1}{24}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$

$\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$

$\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$

$\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ 1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/4

1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/4 1/4 Ohm

For example

Example

– A machine with the same resistance giving twice the E. M. F. will be four times as effective. In order to do this four times the amount of wire must be used on the armature

60 machines
10 miles of wire Aug 12

Machines such that 150 Volts can be obtained on 1/4 of an Ohm. Transmitting and receiving machines the same Receiving machine run so as to have an E. M. F of 100 Volts.

---

92 % machines
92
184
828
836

84% of energy delivered by the machine in of the work

92% of energy in current That is only one machine enters into the turning of the power into electricity while both machines are concerned in the converting of the power into work.

A machine will cost about

$$\frac{8\overset{9}{\cancel{1}}\cancel{000000} \times 44.3}{\underset{4}{\cancel{12}} \times \underset{11}{\cancel{33}}\cancel{000}} = 9000 \text{ about}$$

$$60\overline{)9000}$$
$$150$$

$125 delivered

1/5 of a Horse power used on the magnets

2 machines required to drive the magnets $250

Question how to drive the magnets

A wire running ten miles separate would cost far too much.

If ~~it~~ they were driven by two ~~ma~~ receiving machines there would have to be two transmitting machines for them making expense $500 + 250 = $750

Perhaps best to drive them as a shunt from main circuit

60 machines 9000 Volts

$$\frac{9000^2}{x} \times 44.3 = 12 \times 33000$$

$$x = \frac{9000^2 \times 44.3}{12 \times 33000} = 9000 \text{ Ohms}$$

150 Ohms on a machine in the magnets

There would be then 150 Ohms on each magnet. This could be made less by placing the shunt further along on the line around say 1/2 of the machines 30,

Then the resistance on the magnets would be $\frac{150}{4}$ = 37.25 Ohms. This would make part of the machines some what more efficint than the rest. ~~but~~ It could be arranged so that the resistance would be around 3/8 of the machines and these 3/8 made so as to give a greater E.M.F. and thus to balance the loss in the other due to the shunt so that they would take up their share of the energy. The magnets could be made stronger on these machines or more wire placed on the armature.

Any way the magnets can be taken care of by putting ~~mo~~ transmitters, enough more on to ~~moto~~ give off ~~three~~ 12 horse power

Insulation must be so good that even with an E. M. F. of 9000 Volts on the line the leakage will not be ½%.

The tendency of such an enormous E. M. F. will be to dry the insulation by decomposing any water on the glass.

It is proposed to pass the wire over glass insulators the same as on telegraph poles and it is calculated that the price 25 cts. per lb. will pay for the building the line as well as for the insulation

One ~~[illegible]~~ contrivance will be necessary - a governor to cut off the current when the speed is too great. This will be necessary for if the belt on one of the receivers breaks ~~A~~ that ~~[illegible]~~ dynamo will tend to go as fast enough to equal the E.M.F of all the transmitting instruments.

The cost of a horse power in the water wheels may be taken ~~ss~~ as $25 ~~[illegible]~~.

[illegible] 3000 volts active

~~60 Transmitters~~ 60
~~60 receivers~~
~~120~~
~~30.75 Ohms~~ 30 Ohms

20 Ohms in machines
5 Ohms in conductor
35 Ohms

$$\frac{3000^2}{35} \times \frac{44.3}{.33.000}$$

	9000000	6.9542
comp	35	8.4559
log	44.3	1.6464
comp	.33.000	5.4815
		2.5380

345 H.P. Resistance given off
2
690 Horse power in work

Correction

$\frac{1.00}{92} =$ 2.
1.
9.0362

$= 1.087$
2
1.174

2.5380 = log 345 or H.P — resistance
0.0362
2.5742

375.2

log 2 .3010
2.8752

750.
1125.2

690 2.8386
.92 1.
690
8280
552
634.8

allowance for receiving machines

635 Horse power given off

25 Horse power for magnets

1125.2
25
1150 Horse power taken

134

125
60
7500

4 Dynamo machines for the magnets 500
60 " " " Transmitters 7500
60 " " " Receiver 7500
Conductor 4500
$ 20,000

Cost of wire 135

~~$ 21780~~
~~25~~

~~4.3381~~
~~1.3979~~
~~2.9402~~

~~$871~~

5/21780
$ 4356

Cost of power

$ 1150
25

1/115000
$ 28.750

Cost of machines
4 for magnets $ 500
~~120~~ 120 for ~~power~~
125
120
13.000 ~~power~~ ~~Dynamo~~ $ 15,000 Dynamo
28.750 power
Conductor 4,356
$ 48.106

Say $50000

50000	4.6990
635	2.8028
	1,8962

$78.70 per Horse power

---

60) 112.5
18.75 Horse power from a machine

---

page 118 $100 at 10%
1.14 mills per hour
.557
5% for repairs 1.7 mills per hour

1/2 Ohm~~s~~ machines

65 Ohms total

$\frac{35}{65}$ of Horse power as in case with 35 Ohms total

$\frac{7}{11}$

11)70(636
~~66~~ 40

635
.636

2.8028
$\bar{1}$.8037
2.6065

404. H.P. delivered

1150
.636

3.0607 p. 133
$\bar{1}$.8037
2.8644

732 H.P. taken

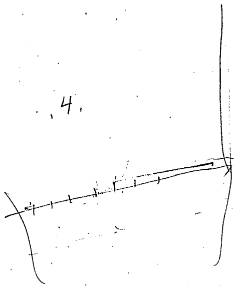
(73200
$ 18300

Water 18300 p 135
Dynamos 28750
4356
$ 51406

Water 18.300
Dynamo 15.000
Conductor 4.356
$ 37.656

Say $ 38.000

10000
44000
440000



400)38000
$95 per H. P delivered

$20.000 for the apparatus
for transmitting 635 horse power
five miles no earth return wire
and requiring 1150 horse power to
drive it see page 133

1/2 the power lost in Transmitting

$20.000 $20.000 $20.000 $20.000 $20000
$20000
$20000
$20.000 $20000 $ $ $ $20000
$20.000 $20.000 20.000
20.00 20000 2000

20000

1150 : 635 :: 100 : 55

```
1150)63500(55
     5750
      6000
      5750
```

$55\frac{a}{10}$ per cent
of power given
to machines recovered

$100 $100 $100 $100

Interest on $100 $100 $100 $100

$100 $100 $100 $100 $100 $100

$100 $100 $100 $100 $100

250 $200 150 100 90 80 ~~75~~ 60 50 40 30 25 20

10% 15% 10% 15% 10% 15%

6 days a week

per day

per hour

6 hours a day

8 hours a day

10 hours a day

7 days a week

---

635)20000(31.3
1905
950
635
2150

$31.30 per H.P. for transmitting power

365)31.30(

Interest

365)$3.13.0(8
~~3320~~
~~6~~00

365)3130(8.5
2920
2100

8.5 mills per day

8.5 mills per day

30 inches

30 inches.

30 inches inches.

30 inches inches.

inches inches

inches

30 inches

30 inches

30 inches

30 inches

30 inches

30 inches

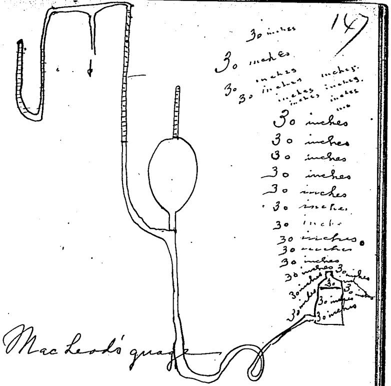
30 inches

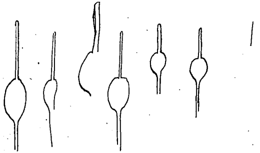
30 inches.

30 inches

30 inches

30 inches


MacLeod's guage
30 inches
30 inches
30 inches
30
30 inches
30 inches
30 inches
30 inches



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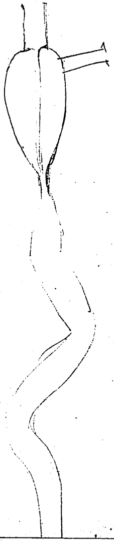
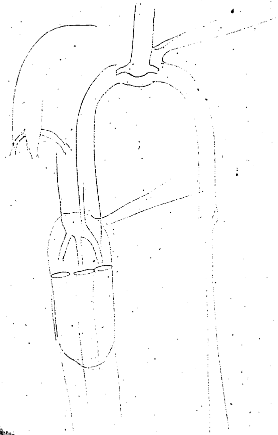
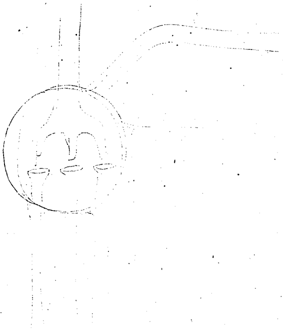


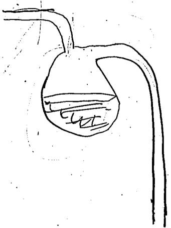


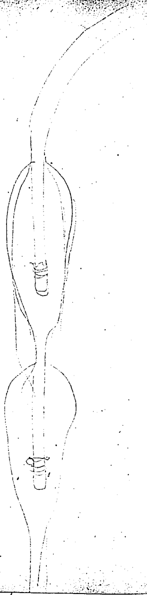


27

1000 900 800 750 640 500 400 250 200

150 100





6⟌27.4

27.4
13.7
411

10.96
1.83
1279

274
9
24.66
1233
3699

274
8
21.92

6⟌27.4
4.57
31.97
2055
342
2397

13.7
2.3
120

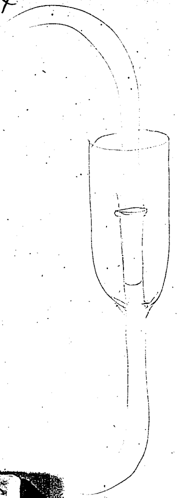
274
60
1644

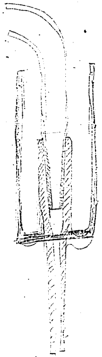
124.66
4.11
2877

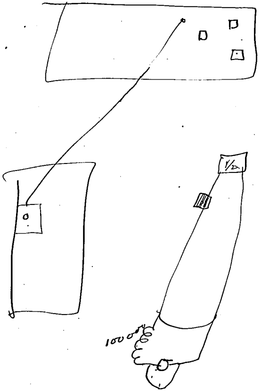
6⟌21.92
365
2557

1644
274
1918

27.4
~~6.50~~
2055






1/D
1000

10 Volts active

---

10 Volts active

I want a full account of experiments performed

Rorchester

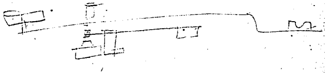
Belcher

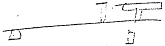
Belcher

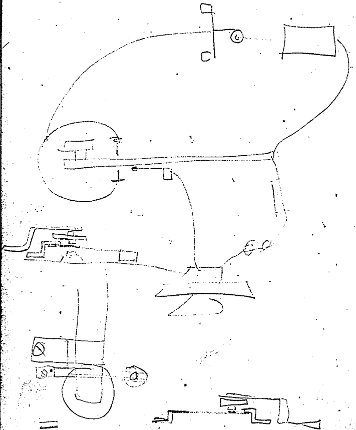
Belcher.

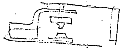
Pure chalk, 1 oz 16 pennyweight,

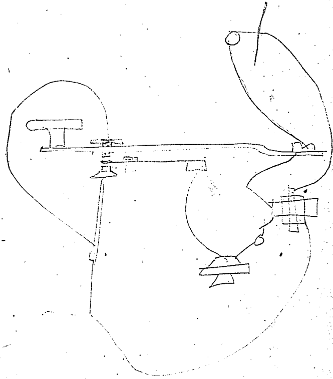
~~36 penny~~ chalk same pressure always — balanced lathe slow turning — fine feed — flat $\frac{1}{8}$ inch palladium, just resting on chalk but with no pressure.

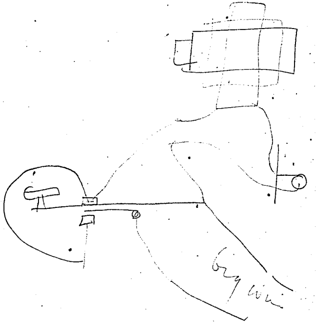





a
a



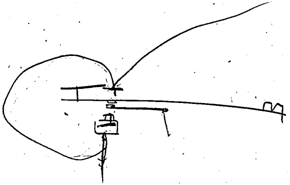



big wire

25 ft

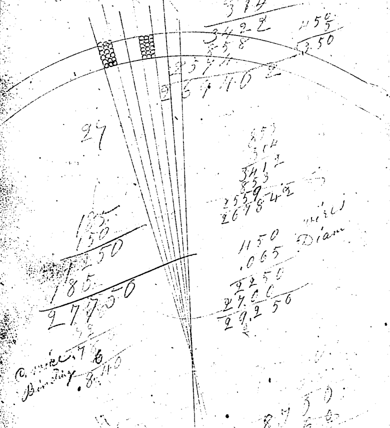
450
65
2250
2700
29250

144
24
576
3456
342
2592
450)27.1296 = 6B
270
1296



10.25

9.70.
0 3
0 3
2 2
2 2
2
2
1
10.25



858
314
3432
858
2574
269412

1150
3.50

27

185
150
1250
185
27750

Copper wire .76
Binding .840

858
314
3412
853
2559
267842

1150 wire
.065 Diam
5750
6900
74.750

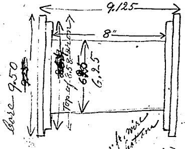
8750
6.00
Dia Fibre 8.50

Faradic Machine No. III

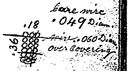
Outside Diameter of armature = 9.25 over the copper wire

Outside Diameter of Iron wire = 8.53

Diameter of wooden core 6.25


9.125
8"
Base 9.50
Top of 8.58 bottom
6.25

12


bare wire .049 Diam.
.18
.36
wire .060 Diam over covering

.060
circ. 26.7842
450)26.7842 = .5952 Hcom ft. wire at the bottom
2250
4284
4050
2342
2250
920

8.6

H 258

9.25
.72
8.53
3.14
3412
853
2559
26.7842 circ.

4331.25 feet of wire .049 Diameter = .0517 ohms where the comutators are on, weight of wire = 31.46 lbs.

Copper wire .780.
Binding " .060
Space .060
= .920

Bore 9.500 Diameter
920
8.580 Diam. of Fibre

6 33 5.5
1 2
110
55
60

38.5
18
3080
385
693.0 = 57.75
990

miri

11) 40,07.05

19.25
75
9625
13475
1443.75

1443.95
3895
6884
10610
1056
1

171

1706

162) 2481.25
1161
1134
292

17016
-1764

1764
1
9025

5775
75
28875
40425
433125

162)

60
27

78
6
468

42
42
84
168
1764

45
45
225
180
2025

19.25

38.5
1

19.25
75
9625
13475
1443.75 = 481.25

3) 1443.75 = 481.25 = 2.8

140.6) 481.25
3412
14005
13648

19.25
18
15400
1925
346.50
75
17325
2425 50
173.550
242 87.50 of 16.4 lbs

162) 2427
162
978
972
675
648

38.5
18
3080
385
693.0 57.75

12) 693.0
990

1925
3
5775
75
28875
40425
4331.25 = 26.73

162) 4331.25
324
1091
972
1192
1134
585

433125

c045

174

~~Order 32 lbs of Copper wire .045 Diameter Double & Compound Pallas Covered Nov. 1st 1899 C.R.~~

#18 = .049

232.3) 4331.25 = 18.645
2323
20082
18584
14983
13938
10450
9292
11580
11615

.517

1) 18645 = 2.071
64
15

= .517 ohms

= .049 137.68) 4331.25 = 31.46 lbs
41304
20085
13768
63170
55072
80980
82608

450 wires in circum.
.049 Diameter
.011 Covering

450
60
27.000 inches

175

21.5
240
8600
4300
51600
3

9.125
2

18.1/4
18 1/2

36 3/4 miles

3 feet

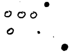
4 | 2700
675 feet

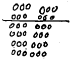
4 | 232.3 feet per ohm
58.) 675 (12
58
95

~~Bore of Faradic Machine No 4 9.218 ins~~
~~Largest Diameter of Armature = 9 inches~~

1/4 Ohm Machine.

3.1416
9
75 | 28.2744





1.45133
1.87506
1.57627

| 250

50 \ 5
50 X 7
12

.3765

.42
50 .11
51
6
300

75
12
150
75
900

3 5/8

.47
3

36 3/4

12 | 36.75
3.06 feet
×75.
1530
2142
2249.50 feet

2295 feet

$\bar{2}$.8129
$\bar{2}$.8129
.4969
$\bar{2}$.1227

2295 feet 1/4 Ohm

.065 in. diam ~~4215~~ 408.7

$(.065)^2 \times 3.14 = .0133$

$\sqrt{\frac{408.7}{.0133}} =$ ~~2958.~~

1240

.745 inches cross section to have 1/4 Ohm

22953.3608
$\bar{2}$.1227
~~2.6113~~
~~4.0948~~
1.4835
2.6113
$\bar{1}$.8722

2295 2295 5959 5959591

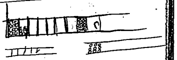
3.1416
8.5
157080
251322
75) 26.76300 (.356
225
426
375
510

.356
.178

5.3
3
159
2
3.48

150

.178



96) 100 (.062
96
40

.062
.062
.124
62

250
3

50

178
33
3 | 143
47

47
3

.356
3
.178

0.47
3.14
.047
2198
1256
.14758

147
9

147
6

250

~~15~~ .200) 26.763

1338

(134

67 commutators

.200
.250

.050
.011
.039

~~2029 50 feet in each~~

67 coils

3.06
67
2142
1836
205.02 feet of wire once round in each commutator .1 in diameter $\frac{967}{4}$ feet = 1/4 Ohm

$$\frac{241.75}{.1} = \frac{205.}{X}$$

20.5
241.

1.3118
2.3832

$\bar{2}.9286$

.0848 ~~diameter~~ sectional area of wire one turn to a coil to give 1/4 Ohm

---

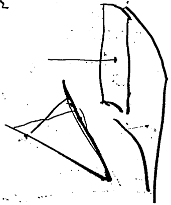
$\sqrt{.0848}$
3.15

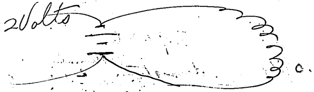
$\bar{2}.9284$
.4983
$\bar{2}.4301$
$\bar{1}.2150$

.164

πR^2

.328 = D



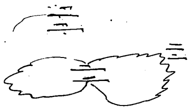


.1

4⟨2.1

.5

.78



63
1.13
4⟨1.76
44.

$C = C + C'$

$C = \frac{1}{R'} + \frac{1}{R''} = \frac{R' + R''}{R'R''}$

$R = \frac{R'R''}{R' + R''}$

$\frac{63}{1.13}$

1.13
.63
339
678
.7119

.711 1.76

$\bar{1}.8519$
0.2455
$\bar{1}.6064$

4

.40.4

3 inches .016

3 inches .010

3320 ft lbs gasjet 10 per H.P.

16
16
96
16
256 100

15 00 ft lbs : 16 candles

40 3000 ft lbs

~~10 per H.P~~ surface .1

Double the 1000

3340

33000

~~33.000~~

~~amp~~ 44.7

100

~~Candle 100~~

2

4

2.5185

1.6464

4.8721

1.1461

3.7260

1.8630

73 Volts

1.8633

1.8633

1.6464

1.1461

1.

8

4.5191

75

75

75 1.8751

75 1.8751

443 1.6464

5.3966

249000

2490

Double the energy on the same surface quadruple the light.

1/2 the surface, and 1/2 the energy 1/2 the light

1/2 the surface same energy 2 times the light

---

300 ft. lbs surface 100

~~25 to one~~ ?

lamps with 50 surface

10 lamps 10 gas jets

10 lamps 20 gas jets

63
4
192

(2.
.106

4. 8
8
64
44.3
64
1772
2658
.06 (2835.20
1 4

~~II~~ 15 lamps

15 lamps

15

15)20(~~1.4~~
15
50
70

14)20(1.4
14
60
56

14
16
84
14
2240)33000(~~14~~ 14.7
2240
10600
8960
1740

.100 in diameter

967.5 feet make 1 Ohm

242 " " " 1/4

$$\frac{242}{(.1)^2} = \frac{2295}{X^2} = \frac{242}{.01}$$

2295 1.3608

242 2.3838

2.9770

1.4885

.308

$$\frac{242}{.01} = \frac{205}{X^2}$$

~~67~~ Machine 8½

1.5
100.
101.5 X 73

$\bar{2}$
1.8569
1.8569
1.6464
3.3602

7300 3.8633
101.5 2.0064
1.8569

2300

71.9 Volts

2

50
51.5

1.8633
1.6990
$\bar{8}$.2882
1.8505

70.9 Volts

$\bar{2}$
1.8505
1.8505
1.6464
3.3474

2220

3

73
33.3
34.8

1.8633
1.5224
8.4584
1.8441

69.8 Volts

1.8441
1.8441
1.6464
$\bar{2}$
3.3346

2160

73
25
26.5

4 68.9 Volts

1.8633
1.3979
8.5768
1.8380
1.8380
1.6464
$\bar{2}$
3.3224

2100 ft.lbs.

5

73 X 20
21.5

1.8633
~~1.3979~~
1.3010
8.6676
1.8319

67.9 Volts

1.8319
1.8319
1.6464
$\bar{2}$
3.3102

2046

---

6 6)100(16.6

73 X 16.6
18.1

~~1.8633~~
1.8633
1.2201
~~8.7670~~
~~1.8504~~
8.7423
$\bar{2}$
1.8257
1.8257
1.6464
3.2978

67.

1980

7 lamps 7/100

14.3

1.5

15.8

73 1.8633

14.3 1.1553

15.8 8.8013

1.8199

66 Volts 1.8199

~~1.8199~~

1.6464

2

3.2862

1930

8 lamp 8/100

12.5

1.5

14.0

1.8633

$\frac{73 \times 12.5}{14}$

.7

73 .10

11.5

63.5

~~22~~

1780

2.8633

1.0607

1.8026

1.8026

1.6464

2

3.2516

3.3602

3.3602

6.7204

6.5032

.2172

3.2516

2

6.5032

1.65

16 candles

.2041

.2175

.9866

9.7

196

73 .100/101 7300

7300 3,8633
.101 2.0043
1.8590
72.4 1.8590
1.6464
3.3644
2316

50/51 ~~1.8633~~
~~1.7076~~
1.8633
1.8990
8.2924
71.5 1.8547
1.8547
1.6464
3.3558
2268

~~33.3~~
~~1.5~~
~~34.8~~ ~~1.8633~~
~~1.5224~~
~~8.4584~~
~~1.8441~~
~~1.8441~~
~~1.6464~~
~~3.3346~~
~~69.8~~
~~160~~

~~1.8633~~
~~1.5224~~
~~8.6585~~
~~2.2442~~

197

73 X 33.3
34.3 1.8633
~~.5185~~
1.5232
8.4639
70.8 1.8504
1.8504
1.6464
3.3472
2276

73 X 25
26 1.8633
1.3979
8.5850
70.2 1.8462
1.8462
1.6464
2182 3.3388

73 X 20
21 1.8633
1.3010
8.6778
69.5 1.8421
1.8421
1.6464
2141 3.3306

198

100/16.6

73 X 16.6
17.6

1.8633
1.2201
8.7545

1.8379
1.8379
1.6464
3.3222

688

2100

100
12.5
13.5

1.8633
1.0969
8.8697

1.8299
1.8299
1.6464
3.3062

67.6

2023

10
11

1.8633
1.
8.9586

1.8219
1.8219
1.6464
3.2902

66.3

1951

199

3.3644
6.7288
6.5804
.1484

3.2902
65804

1.4

16

1.2041
.1484
1.0557

188
24
752
376
18) 4512 = 250
24/376 ~~188~~

565.

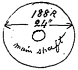
144 D. of Wh.
55 R. of Engine
720
720
46) 7920 inches pr mt.
46 = 172 R. of Shaft
332
322
100

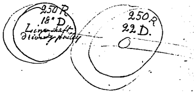
18"D Countre sh. 229 Faradic 10D. 503R

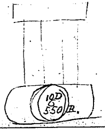
---

144 D. Wh.
65 R. Engine
720
864
46) 9360 inches per mt.
160 = 203.5 R. of Shaft
18"D Countre shaft 271R Faradic 10"D = 596

~~172~~ each R. of Eng. = to 3.13 of Shaft
60 R. of Eng. = .188 of Shaft


188R
24"
main shaft


250R
18" D
Line shaft
driving pulley
250R
22 D.



M

188
O
24

250.7
18

~~601.6~~
~~[illegible]~~
250.7
24

M 172
C. 229.3
F 550

M 203
C. 271
F 650

601.6
10

600 29.178 = 0485

[illegible]

517

[illegible]

150 29.17 = .194

150

1417

1350

670

1

31 . 7

150 28.26 .188

150

1326

1200

1260

950

[illegible] in

858 out

wire 130

[illegible] 40

[illegible] 40

210

9505

210

9290

450

65

2250

2700

29250

429

314

3716

927

2787

29.17 0 0 = 64

2700

21.70

1800

0

450

65

[illegible]

[illegible]

[illegible]

9.500 bare
40 space
40 Binding
47 wire copper & covering
47

174

9.500
174
9.326

40
40
94
174

9490
1744
9.316

Outside Diameter of iron wire = 9.290

Nov 28th 79

Wind Iron wire up to 9.328 Diameter
Fibre ends 9.400 Diameter
Cutter for Fine .188 wire
Thickness of Tooth .007 on top

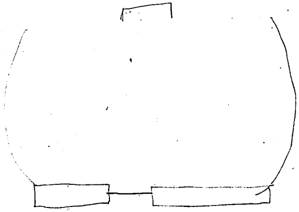
30
30
900
900
3600
396

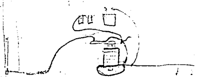
25
25
125
1-0
35
644
3437.

40
40
1600
44
6400
640
6400
7040
8) 7
8800
70400

8) 39600
4487

4





840
4

2)3360

1680

1640

9.62

25

220
220
140
40
20
20
20
20
20
20

.568

9630
0568

9.062

5

905
44

5.9

No 4 Machine

Diameter of wooden core	6.25"
Distance between iron flanges	8.25"
" " vibre "	8.75"
iron wire .075 square	
Diameter over iron wire ~~of~~	9.05
" of core	9.63
" " Fibre	9.55

216

39 ½ " pr [illegible]

12 wires

= 39.5 ft. pr. coil

75 Commutators

[illegible]

1874 [illegible] ft pr coil

1874
10885 = 15.87
2644
9370 15,87

15150
13118

2032
1874
1580

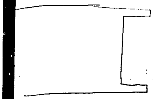
4) 15.87 – 9) 3.967 = .44

217

450
55

2250
2250

24750

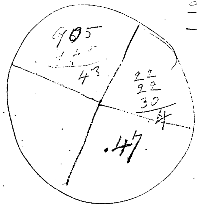


905
3??

3620
905
2415

28.4170
24.75

150) 3.06.2



2475 2925.
450

2841
45

94) 2925 = 93
2826

00790

731
47
778

125

Faradic Machine No 3
Jan. 5th 1880 D

Diameter of bore - -	9.75
" " Armature over all.	9.67
" " " " iron	9.19
~~" " [illegible]~~	~~[illegible]~~
" " wooden core	6.25
" " shaft	1.625
" " brass box outside	—
" " " " inside	1.25
Thickness of Coils for Field	.168

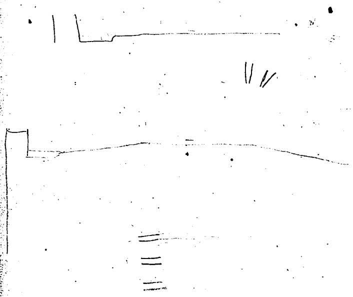
-150 Divisions

Faradic Machines 5,6,7,8,9,10,
Jan. 5th 1880

Diameter of bore - -	9.75
" " Armature overall	9.67
" " " " iron	9.19
" " Wooden Core	6.25
" " Fibre ends	9.67
" " Shaft	1.75
" " brass box outside	2 —
" " " " over flange	2.50
" " " " inside	1.50
" " Pulley	10 —
" " " over flanges	12 —
" " Commutator	5 —

Shafts marked 1 have large Bore & Thin plates
" " 2 " small " " "

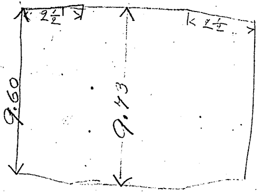
Distance from base to centre	5.75
" between fibre ends	8.75
Length of bearing	5.75
" " shaft total	
" " " between bearings	
" " " Commutator	
" " " armature heads	



April 3d 80

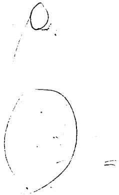
Dynamos Nos from 10 to 22

Diameter of bore 10.25
" " Fibre 10.19 10.7
" " Iron core 9.70

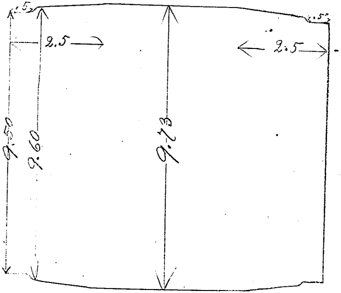


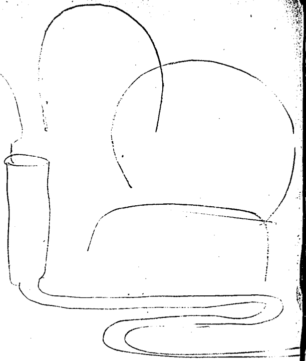
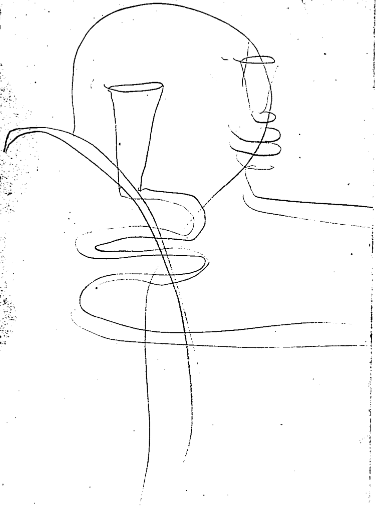
Shafts marked 1 have large com's thin plates
" " 2 " small " " "

1/2 386 ~~[illegible]~~ FS Barley
1/2 No 3 5" Barley
1/2 " 4 2" △ "
1/2 " 3 2" △ B.P.
1/2 " 3 6" □ 1 [illegible] "
1/2 " Round 4" No 3 [illegible]
1/2 " 4" No 5 [illegible]
1/2 No 4 △ B[illegible]
1 Reg No 2 [illegible] 9.
1 " " 3 "
1 " Hand 9" No 5 B
1/2 " " 7 " 6 B
1/3 3 1/2 Pillar 1/2 L No 8. 9.
1/3 No 4 & 8 6 4 1/2 F.S B



Iron Cases for
Mach. No 15. 16.17.18.19.20&21.


.5
2.5
9.50
9.60
9.73
2.5
.5

April 20 1880